CLAIMS

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method for forming a three dimensional soft magnetic metal mass suitable for milling, comprising the steps of:

wrapping a soft magnetic metal ribbon into a three dimensional shape;

applying an adhesive to the three dimensional shape to allow permeation of the adhesive into the three dimensional shape; and

curing the adhesive.

2. The method of claim 1 where the step of applying an adhesive to the three dimensional shape comprises an ambient atmospheric soak process.

3. The method of claim 1 where the step of applying the adhesive comprises a wet spray process applied during winding.

4. The method of claim 1 where the step of applying the adhesive comprises an electrolytic deposition process during winding.

5. The method of claim 1 where the step of applying an adhesive to the three dimensional shape comprises:

providing a vessel containing adhesive;

immersing the three dimensional shape in the adhesive; and

evacuating the vessel.

6. The method of claim 2 or 5 where the step of curing the adhesive comprises the step of heat treating the three dimensional shape.

7. The method of claim 6 where the soft magnetic metal ribbon has a thermal processing temperature, and the step of heat treating the three dimensional shape occurs at a heat treating temperature, and the heat treating temperature is a fraction of the thermal processing temperature.

8. The method of claim 7 where the fraction is about ½.

9. The method of claim 7 where the fraction is about ¾.

10. The method of claim 7 where the fraction is about ¼.

11. A three-dimensional soft magnetic metal mass suitable for milling made in accordance with claim 1.

12. A method for forming a soft magnetic metal toroid suitable for milling comprising the steps:

winding a soft magnetic metal ribbon into a toroid;

applying an adhesive to the toroid; and

curing the adhesive.

13. The method of claim 10 where the step of applying an adhesive to the soft magnetic metal toroid comprises an ambient atmospheric soak process.

14. The method of claim 12 where the step of applying an adhesive to the soft magnetic metal toroid comprises:

providing a vessel containing adhesive;

immersing the soft magnetic metal toroid in the adhesive; and

evacuating the vessel.

15. The method of claim 13 or14 where the step of curing the adhesive includes a step of heat treating the toroid.

16. The method of claim 12 where the soft magnetic metal ribbon has a thermal processing temperature, and the step of heat treating the toroid occurs at a heat treating temperature, and the heat treating temperature is a fraction of the thermal processing temperature.

17. The method of claim 16 where the fraction is about ½.

18. The method of claim 16 where the fraction is about ¾.

19. The method of claim 16 where the fraction is about ¼.

20. A method for manufacturing a soft magnetic metal electro-mechanical component comprising the steps of:

winding soft magnetic metal ribbon into a toroid;

containing the toroid within a toroidal geometry;

milling the toroid into a electro-mechanical component shape; and

thermally processing the electro-mechanical component shape into a electro-mechanical component.

21. The method of claim 20 where the step of containing the toroid within a toroidal geometry comprises the steps of:

applying an adhesive to the toroid; and

curing the adhesive.

22. The method of claim 21 where the step of applying the adhesive to the toroid comprises an atmospheric soak process.

23. The method of claim 21 where the step of applying adhesive to the toroid includes the steps of:

providing a vessel containing the adhesive;

immersing the toroid in the adhesive; and

evacuating the vessel.

24. The method of claim 22 or 23 including a step of curing the adhesive.

25. The method of claim 24 where the step of curing the adhesive at a heat treating temperature and the step of thermally processing the electro-mechanical component shape occurs at a thermal processing temperature, and where the heat treating temperature is a fraction of the heat processing temperature.

26. The method of claim 25 where the fraction is about ½.

27. The method of claim 25 where the fraction is about ¾.

28. The method of claim 25 where the fraction is about ¼.

29. The method of claim 20 where the toroid has a ribbon winding axis, and the step of milling the toroid into an electro-mechanical component shape comprises milling the toroid with the cutting tool rotating in an axis perpendicular to the winding axis.

30. The method of claim 20 where the toroid has a ribbon winding axis, and the step of milling the toroid into an electro-mechanical component shape consists of milling the toroid with the cutting tool rotating exclusively in an axis perpendicular to the ribbon winding axis.

31. An electro-mechanical component made in accordance with claim 20.

32. A method for manufacturing a soft magnetic metal electro-mechanical component comprising the steps of:

winding soft magnetic metal ribbon into a toroid;

containing the toroid within a milling assembly;

applying an adhesive to the toroid;

curing the adhesive;

milling the toroid into an electro-mechanical component shape; and

thermally processing the electro-mechanical component shape into an electro-mechanical component.

33. The method of claim 32 including the step of:

removing the toroid from the milling assembly.

34. The method of claim 32 where the toroid has an inner side surface, an outer side surface, a top and a bottom.

35. The method of claim 34 where the step of containing the toroid within a milling assembly comprises placing an inner ring circumferentially about at least a portion of the inner side surface.

36. The method of claim 34 where the step of containing the toroid within a milling assembly comprises placing an outer ring circumferentially about at least a portion of the outer side surface.

37. The method of claim 34 where the step of containing the toroid within a milling assembly comprises placing a hat on at least a portion of the top.

38. The method of claim 34 where the step of containing the toroid within a milling assembly comprises placing a base on at least a portion of the bottom.

39. The method of claim 34 where the step of containing the toroid within a milling assembly comprises the steps of:

placing an inner ring circumferentially about at least a portion of the inner side surface;

placing an outer ring circumferentially about at least a portion of the outer side surface; and

placing a hat on at least a portion of the top.

40. The method of claim 39 where the inner ring is placed about substantially all of the inner side surface.

41. The method of claim 39 where the outer ring is placed about substantially all of the outer side surface.

42. The method of claim 39 where the hat is placed about substantially all of the top.

43. The method of claim 39 where a milling plate is placed about substantially all of the bottom.

44. The method of claim 39 where the hat and the outer ring are integral.

45. The method of claim 39 where the hat, outer ring and inner ring are integral.

46. The method of claim 39 including the step of placing a retainer around the outer ring to secure the toroid within the milling assembly.

47. The method of claim 40 including the step of providing milling grooves within the milling assembly.

48. The method of claim 32 where the toroid has a ribbon winding axis, and the step of milling the toroid into a toroid shape consists of milling the toroid primarily in an axis perpendicular to the winding axis.

49. The method of claim 32 where the toroid has a winding axis, and the step of milling the toroid into a toroid shape consists of milling the toroid exclusively in an axis perpendicular to the winding axis.

50. The method of claim 45 where the toroid has a winding axis, and the step of milling the toroid into a toroid shape consists of milling the toroid primarily in an axis perpendicular to the winding axis.

51. The method of claim 45 where the hat and outer ring have slots, and the step of milling the toroid into an electro-mechanical component shape includes milling through the slots.

52. The method of claim 45 where the toroid has a winding axis, and the step of milling the toroid into an electro-mechanical component shape consists of milling the toroid with the cutting tool rotating exclusively in an axis perpendicular to the winding axis.

53. The method of claim 50 where the where the hat and outer ring have slots, and the step of milling the toroid into an electro-mechanical component shape includes milling through the slots.

54. A soft magnetic metal electro-mechanical component made from the process of claim 32.

55. A method for manufacturing a soft magnetic metal electro-mechanical component comprising the steps of:

winding soft magnetic metal ribbon about a winding axis into a toroid, the toroid having an inner side, an outer side, a top and a bottom;

placing an inner ring on the inner side;

placing an inner containment hat on the top and inner side;

placing an outer containment hat on the top and outer side;

placing a retainer around the outer containment hat;

applying adhesive to the toroid;

curing the adhesive;

milling the toroid into an electro-mechanical component shape; and

thermally processing the electro-mechanical component shape into an electro-mechanical component.

56. The method of claim 55 where the inner containment hat has a plurality of inner containment hat slots and the outer containment hat has a plurality of outer containment hat slots, and the step of milling the toroid into a electro-mechanical component shape comprises milling through the inner containment hat slots and the outer containment hat slots.

57. The method of claim 56 including a step of aligning the inner containment hat slots and the outer containment hat slots.

58. The method of claim 55 where the step of milling the toroid into an electro-mechanical component shape occurs with the cutting tools rotating primarily on an axis perpendicular to the winding axis.

59. The method of claim 55 where the step of milling the toroid into an electro-mechanical component shape occurs with the cutting tools rotating exclusively on an axis perpendicular to the winding axis.